WHAT IS THE FUTURE OF OUR PROFESSION ?

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Commission VI, Invited Paper

KEY WORDS: Population growth, Global networking, Career, Market, Tools, Products

ABSTRACT

The subject must be kept as much as possible free from speculations. Having this in mind, technical as well as non-technical elements are brought together which will determine the future of our profession. The extreme width of components of our profession will be shown together with indicators, which characterise a profession. The indicators are then assigned to "Photogrammetry and Remote Sensing", referring both to the past and the future. Finally, conclusions of the analysis are given in form of theses and questions as well as some proposals to master the "future of our profession".

KURZFASSUNG

Das Thema muß so weit wie möglich von Spekulationen frei gehalten werden. Dazu werden zunächst technische und nicht-technische Elemente zusammengestellt, welche unsere Zukunft bestimmen werden. Anschließend wird gezeigt, daß unser Beruf eine extreme Breite von Komponenten aufweist, daß es aber Indikatoren gibt, welche einen Beruf grundsätzlich charakterisieren. Diese Indikatoren werden nun subsumiert auf "Photogrammetrie und Fernerkundung", und zwar sowohl in Bezug auf die Vergangenheit als auch mit Blick auf die Zukunft. Schließlich erfolgen Bewertung der Analysen in Form von Thesen und Fragen sowie einige Vorschläge, die "Zukunft unseres Berufes" zu meistern.

1 WARNING: DO NOT EXPECT PRECISE ANSWERS

In the title there are two concepts which show a significantly high level of fuzziness:

"future" and
"our profession".

Prediction, if not applied in statistics, is sheer speculation. To make this clear, let us go ten years back and consider which (technical, personal, political ...) event was really predictable then.I dare say that order of magnitude of the changes in the next ten years will be similar to those encountered in the past ten years - if not more.

"Our profession", on the other hand, shows no consistency at all. We are going to analyze this field in more detail in paragraph 3. Consequently, the following constraints should be kept in mind: the question in the title, combining two fuzzy elements ("future" and "our profession") can not be expected to be answered significantly and to our full satisfaction. It is basically an "ill-posed" question. The well known procedures of "error propagation" illuminate this limitation very clearly.

We are all responsible for analyzing the present status and the changing role of our profession in order to plan and prepare for the future:

"Temos, todos nos,
Por ação ou omissão,
Estimulo ou incompreensão,
Responsabilidade dos fatos da historia"
(Teotonio Villela, Osorio Square Curitiba/Brazil)

2 KEY ELEMENTS WHICH WILL DRIVE THE FUTURE

Which elements are significant for the future of our profession and will they be predictable?

There will be a growing demand for data of our environment due to dynamically developing key features.

This applies primarily to the growing population: after 4 billion in 1975 and 5.8 billion in 1995, ten billion are expected in the year 2010 (Linkwitz 1995). Even if growth rates are slowed down there will necessarily be growth.

Problems and challenges produced under these conditions were tackled in the past, at least partly, by "technology". The so-called "technical revolution" is still under way as we do not observe in principle a difference between the introduction of the steam engine, television or the digital computer. In all cases, "paradigmatic" shifts (Ackermann 1995) were produced resulting in even faster growing technical possibilities. Analyzing the present status and trend of technology no "limits to growth" may be expected during the next years.

In the field of technology, the key elements which will drive our profession are in Sensor Development, Computer Science and Communication Science. It is not the purpose of this paper to analyze the individual trends in detail but to draw conclusions from the obvious overall change. In this respect we have to accept that technical innovation is coming from outside of Photogrammetry and Remote Sensing. In the long run, this might be a "killing factor".

On the other hand, Photogrammetry and Remote Sensing provide data about our environment based on numerical imaging techniques, including data processing, visualization of the results and quality control. There is a growing demand for "our products" for the reasons given above. Consequently, the future of our profession in the field of application can be seen far more optimistically than in the domain of technology. However, what does "our products" mean in the future?

Changing technology will change the products: data of the environment will be required and asked for in 4-D, i.e., including a fully 3rd. dimension and temporal change. Data access will be needed "on-line" and nicely visualized in many cases. Finally, there is a strong trend away from "just data" towards

"intelligent" products, which give alternatives or suggestions for decisions.

Are we sure to be able to meet the demands of the future market? Competitors from other disciplines like Computer Science are already strong and will be stronger in the future. This applies dramatically for companies which produced photogrammetric hardware components in the past.

As a result from fast growing population and fast growing technology, a series of problems in the political and socio-economic domain will increase: Pollution of man s environment does already exceed the acceptable standards in many regions. Ethnic conflicts and migration of people are indicators of a changing world.

A key concept is "globalisation". In the future, even today, an event is globally noticed and very quickly may have global impact. This relates to all mentioned fields, like growing population, growing technology, growing pollution and growing social conflicts.

3 "OUR PROFESSION"- WHAT DOES IT STAND FOR?

3.1 About the name

If we simply take the name of our society, our profession could be called "Photogrammetry and Remote Sensing". This is, of course, not consistent, as "Remote Sensing" was added in the seventies to the traditional, internationally recognized greek term "Photogrammetry". Thus, a wider range of activities covered by our professional field was marked. This happened in most countries, but not in all. In the seventies, a wide, controversial discussion developed whether it would be wise to "just add on" the new concept of "Remote Sensing", to leave "Photogrammetry" as it had always been or to take even just "Remote Sensing" instead of "Photogrammetry".

It is interesting to remember the discussion now as we are again in a similar situation: "Digital image processing" on one side and "Geoinformation Systems" on the other are examples for fast developing fields - outside of "Photogrammetry and Remote Sensing"!- which possibly requires modification of our name. I shall not discuss here whether the proposal from Wuhan/China to take "Iconic Informatics" (Deren Li,1992) or "Geomatics" form Quebec/Canada would be good alternatives. By the way, Kraus mentions that "Photo" refers to "photones" and, consequently may be used for both photographic and non-photographic imagery.

Anyhow, the present discussion reflects a changing techincal environment for our profession. As experienced twenty years ago, a change of name would have to go together with changing concepts instead of a "just add-on" procedure.

3.2 About the nature of "Photogrammetry and Remote Sensing"

Where is our profession located in Science? Depending on the view, it has strong relation to

Natural Sciences
Engineering Sciences
Political Sciences

Taking e.g. sensor development, it starts with basic Physics. Turning the sensor operational is an engineering task, and employing the sensor in a real application like mapping or monitoring of the environment, involves many socio-economic features which we may assign to "Political Sciences".

It has to be pointed out here, that the nature of the three fields differs significantly:

Natural Sciences: search for "truth"

Engineering Sciences: solving technical problems

Political Sciences: solving socio-economic problems

(Bähr, 1995a)

Photogrammetry and Remote Sensing will mostly be related to Engineering Sciences and the limits to Natural Sciences and Political Sciences are flowing. However, we have to be aware of the very different concept and methodology people in the respective field apply to reach their final goal. The "final goals" - designing a mathematical algorithm, operating a system, controlling rainforst cut - determine the view of the individual professional.

3.3 Manifold dimensions

A profession in general is a function of *time* and *space* and there exist still more dimensions.

As far as *time* is concerned, our profession is highly technology driven. Fast changing technical conditions have to be reflected by corresponding changes in tools and products and finally by the professional image. This is the main topic of this paper.

Space stands for regional conditions of Photogrammetry and Remote Sensing. In the course of this century basic developments in our field of activity occurred mainly in Europe and North America, although application, particularly in mapping from areal and space platforms, was largely performed in and for the Third World.

The background of this paper is mostly from Central Europe, USA and Brazil, putting together very different social and economic environments. The professional image varies significantly: in Central Europe, one becomes photogrammetrist by education; in USA and Brazil by experience ("by doing"). Whereas in the USA a large open market of photogrammetric companies exist (see paragraph 4), Photogrammetry in Brazil is limited to some big companies, excluding national and international competition.

Principally, the respective markets design the regional conditions for the differing image of our profession in the spatial context. Today we encounter globally a dramatic new distribution of economically active and successful regions like south-east Asia and partially Latin America. In Europe, too, we observe a trend to lower legal restrictions in countries of the European Union (EU), and some even see new markets in Eastern Europe. All this must necessarily exert a significant impact on our own professional field.

A third dimension can be found in the different professional levels. Not considering applications at this point, we have three levels of education ("academic", "engineer" and "technician") and three types of activity ("research and development (R+D"), "project level" and "operational level"). There are, of course, no rigid limits between the particular sectors. This is graphically shown in a matrix (Fig. 1).

As we know, the field of activities of our profession is indeed confusingly broad, especially when adding more dimensions like the large spectrum of applications (from "on-line industrial control" to "monitoring global environment") and

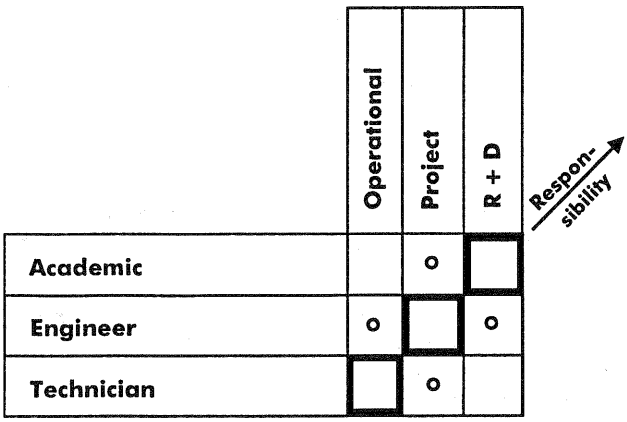

Figure 1: Levels of education related to types of activities in a profession. The diagonal marks main responsibility, the N4 neighbourhood, reduced responsibility.

working environment (from "universities" to "camps in the bush").

4 A QUICK LOOK TO A MARKET

Analysis of open positions in the Journal of Photogrammetry and Remote Sensing (1995) gives an overview of the present US market for openings in Photogrammetry, Remote Sensing, GIS and related fields in all levels, from chairholders to operators.The investigation lead to the following result:

65 positions for photogrammetric operators (mostly conventional plotting)

15 positions for academics (R+D)

10 positions for sales representatives

10 positions for GIS

There was surprisingly little concern about "progessive" fields like "data network support funcions", "multimedia" or "quality control". As a "progressive" example we give the text for a position open for a research scientist ("cartography/GIS") at The Ohio State University (PERS, 1995, p.219):

"... The candidate should have a strong background in Theoretical Cartography, Quality and Quality Control Issues, Visualization, modern Map-Updating techniques, GIS design and implementation. A strong understanding of Least-Squares-Adjustment, Mathemetical Communication Theory, Linguistics, Holography, and Distributed Processing of Multiplatform Systems are a plus. Strong programming skills in C/C++ are highly desirable. The position requires a PhD in Geodesy, Cartography, Geography, Geographic Information Systems, or related fields ...." ("Whow....!")

In nearly all cases related to GIS or Remote Sensing, a combination of both was required. The interdisciplinary concept obviously develops primarily in this environment. It may drive away from Photogrammetry towards softer geographic applications.

The somewhat "traditional" image of today Photogrammetry in the USA given by the open positions is also reflected in the advertisements of the companies. Main services offered are "Aerial Photography" and "Mapping" advertised by dozens of companies. Modern equipment is mostly used, like FMC-controlled cameras, GPS and "digital" mapping. But it is not cear what "digital" really means in this environment: does it only mean "computer supported" or does it refer to soft copy methodology? For "Digital Orthophoto", however, the approach is clear since it has already been operationally established.

5 KEY ELEMENTS WHICH DRIVE A PROFESSIONAL WORLD

In the preceding paragraph, particularly the diversity was addressed. We may, however, rise the level of abstraction and put together significant common elements which drive a profession. There exist characteristic elements which represent strong indicators for a robust professional world:

a) Specific tools, procedures and products

b) Volume of demand for operational output (data, information, service, consultancy)

c) National and international standards

d) Legal recognition

e) Specific education (different levels)

f) Established professional careers (different levels)

g) National and international societies, journals, meetings, etc.

The list is a generalization, valid for any profession and has to be checked with respect to Photogrammetry and Remote Sensing looking both backward and forward. As mentioned earlier, the answers will depend on each country and we have primarily the conditions in Central Europe, USA and Brazil in mind.

Looking backward, it is relatively easy to show what elements made our profession "big and strong". This applies characteristically to analogue and analytic photogrammetry: specific tools, procedures and products were in interaction with a strong demand for the output, particularly analogue and digital mapping. As a consequence, *operational procedures* were established based on national and international standards. *This is an indispensable step for the success of an approach.* In conjunction training in Photogrammetry became part of cartographic education in most countries and professional careers were offered for "specialists in Photogrammetry". In the academic domain, national and international societies together with journals and meetings completed the scenery.

At this point we have to state two facts:

Photogrammetry was a highly specialised field in the past due to its sophisticated instruments and procedures.

Its main activities were performed in a closed cartographic environment.

As far as Remote Sensing is concerned, these two observations can t be accepted. From the beginning of operational use (about 1972 when ERTS-1 was launched), Remote Sensing was considerably less specialised than Photogrammetry because of its *digital* approach. On the other hand, Remote Sensing was strongly driven by Space Technology and dominated by political constraints of the respective national/international Space Agencies.

Presently, we observe a growing trend towards "commercialisation" of Remote Sensing from Space. Commercially operated Earth Observation Satellites (EOS) of high geometrical

resolution to be expected in the next few years, may dramatically change the present situation.

The common factor in both Photogrammetry and Remote Sensing is that the products are up to now primarily required in the public domain or, even more important, financed by the public sector.

Looking forward, the above listed seven items will continue to be valid because they represent a general structure for the development of a discipline or a profession. However we have to check the elements against the new conditions coming from outside like the mentioned dramatic social, economic and technical changes.

The change clearly starts from item (a): the new tools, i.e. sensors, computers, software packages and "global" networks necessarily lead to absolutely new procedures and products. Leberl (1992) points out that the process "from analytical to digital" is "revolutionary", whereas the step "from analogue to analytic" was just evolutionary".

What are the new procedures and products? What is the *final consequence* of "going digital" and "global networking"? We are far from being able to answer these questions to our satisfaction as mentioned earlier. But we have to recognize that we shall lose "traditionally well established fields" together with operational procedures (b), specific education (e) and established careers (f). Changing tools are key elements which drive a profession and which have a "domino effect" on all the other elements listed above.

6 CONCLUSIONS

6.1 Some theses upon which most of us will agree

(1) Political developments

The expanding population of our world leads, globally spoken, to shortage of food, housing and decreasing quality of life. This goes together with increased environmental pollution and international ethnic conflicts.

This scenery develops a growing demand for geo-referenced data. Therefore, the use of all kind of imagery as a medium for data capture and data storage of the environment will dramatically expand.

However, there is no guarantee at all that it will be Photogrammetrists and Remote Sensing experts who will provide the data.

(2) Technical developments

Technical developments and their consequences cannot be anticipated with certainty. Global networking, dissimination of knowledge and manipulation of opinions will enter all fields of life.

Introduction of new sensors, like commercial EOS, and development of new methods in Photogrammetry and Remote Sensing will continue. However, real innovations will come from outside of our profession.

The trend to shift from specialized "photogrammetric" equipment to widely used general software packages will continue.

Geo-data will be in 4-D in the future

Automation is a principal issue in image processing and will increasingly include "intelligent" components providing proposals for decision making (like " railway time tables").

(3) Conclusions from (1) and (2): Facts we have to accept

The former separation of data acquisition and data use will disappear; real-time systems provide new fields of application.

As a consequence of development in Computer Science and the tendency towards the design and use of simpler systems, photogrammetrists will have to compete with "non-professionals": vanishing artificial protection will give way to "natural selection".

International electronic networking and technologically fast developing countries like China, Brazil and India will lead to a new distribution and new centres of photogrammetric activities, no matter what it will be called.

6.2 Some big questions

(1) The structure of our profession

Which are the prevailing elements that make a profession "big and strong"? Which are those elements in Photogrammetry? Which will they be in the future?

Will there be an "image" of a photogrammetric engineer that characterizes the professionalist unmistakably?

(2) Our profession in relation to others

Which are the main future interactions with other disciplines?

Specifically, how will relations to GIS and Computer Science develop? Will Photogrammetry merge into Computer Science (see Leberl 1992)?

(3) Conclusions from (1) and (2): Rules we might follow to proceede

A change of names is no solution unless it goes together with a new concept.

In the past Photogrammetry was mostly understood as a "surveying technique". In the future our profession will (have to) go far beyond surveying and cartography.

Photogrammetry and Remote Sensing have to prepare for the big market of 4D environmental data and "intelligent" products.

The "academic education" (i.e. all components of teaching and research) has a particular responsibility for the future of our profession. The academic environment has to develop concepts for management of the rapidly growing volume of knowledge. It has to establish and use global nets for dissimination of information and interdisciplinary interaction.

6.3 Optimists and Pessimists

During the Commission VI Symposium in Beijing in 1994, a panel discussion was held on future trends in our profession. Panel members were: L. Fritz, A. Grün, G. Konecny, K. Kraus, S. Murai, D. Tait, J. Trinder, K. Torlegard and Z. Wang. The group addressed the change and the challenges and there was no disagreement about the present status and the future trends in Photogrammetry and Remote Sensing. However, facing the facts, very different conclusions were drawn and the panel was split into two controversial groups: the" optimists" and the "pessimists". The optimists stressed the expanding GIS techniques and that 70% of the costs involved were in data acquisition. This would therefore guarantee excellent conditions for our profession in the future. The pessimists just pointed out that many technological developments which could be of our own domain

are increasingly performed outside of Photogrammetry and Remote Sensing.

The readers of this paper may also split into "optimists" and "pessimists". But the reasons for being one or the other are finally driven by personal experience, views and feelings: again a fuzzy concept like "future" and "our profession".

REFERENCES

Ackermann, F., 1992. Strukturwandel in der Photogrammetrie. Zeitschrift für Photogrammetrie und Fernerkundung, 1/92, pp. 2-5.

Ackermann, F., 1995. Digitale Photogrammetrie – ein Paradigmasprung. Zeitschrift für Photogrammetrie und Fernerkundung, 4/95, pp. 106-115.

Bähr, H.-P., 1995a. Past and future concepts for formation of surveying engineers in the academic environment of Central Europe. In: Think Tank III, Geoinfo TU Wien, Eds. A.Frank and I.Orchard.

Bähr, H.-P., 1995b. Report Commission VI Symposium Beijing 1994. Zeitschrift fr Photogrammetrie und Fernerkundung 1/95, pp. 49-51.

Bähr, H.-P., 1996. Ausbildungsmodelle in Photogrammetrie und Fernerkundung für die Zukunft – für die Praxis? Deutsche Gesellschaft für Photogrammetrie und Fernerkundung, Proceedings Annual Meeting 1995, in print.

Kraus, K., 1993. Leserbrief zum Begriff "Orthophoto". Zeitschrift für Photogrammetrie und Fernerkundung 4/93.

Leberl, F., 1992. Towards a new Photogrammetry? Zeitschrift für Photogrammetrie und Fernerkundung 1/92, pp. 9-12.

Li Deren, 1992. From Photogrammetry to Iconic Informatics. Zeitschrift für Photogrammetrie und Fernerkundung 1/92, pp. 5-9.

Linkwitz, K., 1995. Zur Ausbildung des Geodäten. Zeitschrift für Vermessungswesen 12/95, pp. 591-605.

PE&RS: Photogrammetric Engineering & Remote Sensing, Volumes 1995.